THE CONSTRUCTION OF KNOWLEDGE THROUGH SOCIAL INTERACTION VIA COMPUTER-MEDIATED COMMUNICATION

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With the advance in information and communication technologies, computer-mediated communication—more specifically computer conferencing systems (CCS)—has captured the interest of educators as an ideal tool to create a learning environment featuring active, participative, and reflective learning. Educators are increasingly adapting the features of computer-mediated communication in terms of its potential for not only increasing the learner's access to information—and do so powerfully and successfully—but also facilitating knowledge construction activities. The purpose of this article is to examine social participation and interactive patterns in asynchronous online computer conferences, and whether the interactive nature of computer-mediated communication support and encourage the construction of knowledge through collaborative learning process.

INTRODUCTION

Computer-mediated communication (CMC), more specifically computer conferencing, has captured the interest of educators, especially at developing collaborative and participatory learning communities to promote social construction of knowledge. Computer conferencing has become one of the educational tools to support social interaction among students to facilitate and foster cocreation of knowledge. Computer conferencing systems "help more students learn better by placing them in an intellectual environment that encourages active, thoughtful, and equal participation from all comers" (Althaus 1997, p. 158).

Although computer conferencing systems are a relatively recent phenomenon, they have added new possibilities to educational methods and strategies used by distance educators. While many educators embrace these methods, there is still a lack of clarity of the dynamics of online discussion, and how it may be utilized to foster students' cognitive development (Hara, Bonk, & Angeli, 1998). There are few theories and little empirical research on what

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online collaboration or social interaction is and should be, and how online discussions promote knowledge construction via computer conferencing.

Thus, this study was undertaken to scrutinize the patterns of student interaction and to examine the coconstruction of knowledge taking place in computer conferencing systems. In addition, this study was aimed at guiding researchers and educators in the design and utilization of the efficiency of computer conferencing that could increase collaboration and support learning.

THEORETICAL FRAMEWORK

Social Constructivism

The important assumption of constructivism is that knowledge can be constructed through the recognition of external reality based upon unique set of experiences and beliefs. In constructivism, knowledge is always under construction as a cumulative history of interactions in authentic and meaningful contexts.

Social constructivism, one of the widely accepted constructivist learning theories, emphasizes that learners obtain knowledge and make sense of their experiences through communication as they explore new perspectives, and communicate their understanding with others (Hein, 1991; Jonassen, Davidson, Collins, Campbell, & Haag, 1995; McGuire, 1996; Warschauer, 1997). "Learning is necessarily a social dialogical process in which communities of practitioners socially negotiate the meaning of phenomena" (Jonassen et al., 1995, p. 9). From a social constructivist viewpoint, learner is actively acquiring the knowledge and understanding through social/ collaborative experiential activities.

Vygotsky (1978), most often associated with social constructivism, emphasized the effect of social experiences that occur over time in a contextual and situated synthesis on meaning making, or knowledge construction. Education, according to Vygotsky, is a community-based collaborative reconstruction of experience. Social constructivism contends that knowledge is constructed through social interaction based upon interpretation of information and learning experience within a context.

Social interaction, which is premised on social constructivist principles, is one of the essential components of effective and efficient learning. Social interaction embedded in a distance course increases the enjoyment of learning and the potential for the enhancement of cognitive skills (Parker, 1999). For distance education, computer conferencing is a powerful social constructivist learning tool because it is an effective means of facilitating interaction online by supporting collaboration among learners anywhere at any time.

Computer conferencing can provide intellectual ongoing discussion that allows the learner to participate in in-depth discussions by checking references, referring back to preceding topics, and taking any amount of time to prepare a detailed comment or argument. Furthermore, computer conferencing can be used to facilitate group project work and encourage interactive participation and interpersonal collaboration between instructor and learners and among learners. However, designing and maintaining effective collaborative learning activities such as asynchronous online discussions in distance education is challenging. It is essential to understand the way interactive discussions through computer-mediated communication take place, which promote the coconstruction of knowledge among learners.

CONCEPTUAL FRAMEWORK: THE EVALUATION OF COMPUTER CONFERENCING

Computer-mediated conferencing, in particular asynchronous online discussion, is becoming increasingly a common instructional strategy in higher education because of its potential to support social interaction, collaborative learning, knowledge building, and criti-

cal thinking. Despite its popularity, there are few theories and limited amount of empirical evidence for the claims made about the potential benefits of this medium (Garrison, Anderson, & Archer, 2001; Gunawardena, Lowe, & Anderson, 1997; Henri, 1992; Mason, 1992). Gunawardena et al. (1997) note that "the utilization of [this] medium in education has in many respects outstripped the development of theory on which to base such utilization" (p. 397).

Prior to 1992, few studies focused on the analysis of computer conference transcripts in terms of the quality of learning and educational value (Mason, 1992; Pena-Schaff, Martin, & Gay, 2001). Instead, CMC transcripts were commonly studied using statistical manipulations to determine the number and time of logons, quantity of messages, number and length of messages, number of replies and message chains, and the extent of participation. Although statistical data can provide useful information for researchers, it does not yield information on the construction of knowledge that takes place in a computer conference environment (Gunawardena et al., 1997). According to Henri (1992), "an in-depth study of the meaning of messages will teach us much of interest and importance about the richness of their content, and allow us to pinpoint the information which tells us about learners and learning process" (p. 118).

Gunawardena et al. (1997) developed an Interaction Analysis Model (IAM) that serves as the theoretical framework for this study (see Table 1). Their model was designed specifically to examine "the negotiation of meaning and co-construction of knowledge in collaborative learning environments facilitated by computer conferencing" (Gunawardena et al., 1997, p. 397). The model proposes a five phase evolution of knowledge construction within a group of participants in online discussion: 1) sharing/comparing of information; 2) discovery and exploration of dissonance or inconsistency among ideas, concepts or statements; 3) negotiation of meaning/co-construction of knowledge; 4) testing and modification of proposed synthesis or co-construction; and 5) agreement statement(s) /applications of newly-constructed meaning (see Table 1).

Research Objectives

The adoption of computer conferencing for learning is still relatively underresearched. In spite of considerable research interest in this area, there remains a need for examining the best use of the richness and efficiency of exchange provided by CMC content. It is important to have a better understanding of the potentials of CMC in learning experience. The primary objective of this study was to analyze the value and quality of the asynchronous online discussion for learning experience and knowledge construction through social interaction. Specifically, the aim was to investigate:

- the social participation and interactive patterns in asynchronous online computer conferences characterized by explicit, implicit, or independent interaction;
- whether the interactive nature of CMC exchange support and encourage the construction of knowledge through collaborative learning process; and
- factors that may have influence on the level of knowledge construction.

METHODOLOGY

Setting and Subjects

The data for this study were collected over a 14-week semester from an online master's course offered by the college of education at a large Midwestern U.S. university, designed for K-12 teachers and other educational practitioners including undergraduate and graduate students. The primary focus of this course was on understanding and learning the principles, technologies, and techniques for teaching and learning in a distance education system. The course management tool, WebCT, was used as a main course component and a communication

TABLE 1
Interaction Analysis Model

***PHASE I**: Sharing/Comparing of Information*	
A.A statement of observation or opinion or background information that culminates in a question	[PhI/A]
B.A statement of agreement from one or more other participants	[PhI/B]
C.Corroborating/giving examples (provided by one or more participants) (not used as evidence to support a conclusion)	[PhI/C]
D.Asking and/or answering questions to classify details of statements-triggering	[PhI/D]
E.Definition, description, or identification of a problem	[PhI/E]
***PHASE II**: The Discovery and Exploration of Dissonance or Inconsistency Among Ideas, Concepts, or Statements (This is the operation at the group level of cognitive dissonance, defined as an inconsistency between a new observation and the learner's existing framework of knowledge and thinking skills.)*	
A.Identifying and stating areas of disagreement or inconsistency-difference of ideas or themes	[PhII/A]
B.Asking and/or answering questions to clarify the source and extent of disagreement	[PhII/B]
C.Restating the participant's position, and possibly advancing arguments or considerations in its support by references to the participant's experience, literature, formal data collected, or proposal of relevant metaphor or analogy to illustrate point of view	[PhII/C]
***PHASE III**: Negotation of Meaning/Coconstruction of Knowledge*	
A.Negotiation or clarification of the meaning of terms (building on, adding to others' ideas)	[PhIII/A]
B.Negotiation of the relative weight to be assigned to types of argument	[PhIII/B]
C.Identification of areas of agreement or overlap among conflicting concepts	[PhIII/C]
D.Proposal and negotiation of new statements embodying compromise, coconstruction (creating solutions)	[PhIII/D]
E.Synthesis-(Proposal of) Integrating (connecting) or accommodating information, ideas, metaphors or analogies from various resources—textbook, articles, personal experience	[PhIII/E]
***PHASE IV**: Testing and Modification of Proposed Synthesis or Coconstruction*	
A.Testing the proposed synthesis against "received fact" as shared by the participants and/or their culture	[PhIV/A]
B.Testing against existing cognitive schema	[PhIV/B]
C.Testing against personal experience	[PhIV/C]
D.Testing against formal data collected	[PhIV/D]
E.Testing against contradictory testimony in the literature	[PhIV/E]
***PHASE V**: Aggreement Statement(s)/Applications of Newly Constructed Meaning*	
A.Summarization of agreement(s)	[PhV/A]
B.Applications of new knowledge	[PhV/B]
C.Metacognitive statements by the participants illustrating their understanding that their knowledge or ways of thinking (cognitive schema) have changed as a result of the conference interaction	[PhV/C]

Source: Adapted from Gunawardena et al. (1997).

medium among students. Other than the first meeting of the class for introduction and the last meeting for presentation of group projects on campus, the class work and learning occurred online through WebCT's discussion board.

There were 15 students enrolled in the course. Two were undergraduate students, 11 of them were masters, and two of them were doctoral students. Sixty percent of the students were working full time, 33.3% were working part time, and 6.7% were not working. The majority of students were adult learners, with an average age of 29 and 73% of them working as an educator in different fields such as elementary school computer teacher, secondary school English teacher, social studies teacher, community college instructor, and higher education dean at a community college. Thirty-six percent of the students had never taken a distance education course, whereas 43% of them had taken more than one distance course.

Data Analysis and Instruments

Survey and Interview

Students were asked to complete an online survey consisting of 12 items to collect demographic and descriptive data. The survey was completed by 14 of the 15 students, giving a return rate of 93.3%. An interview with the course instructor was also conducted to obtain background information about the course design and the perceptions of the instructor on the learning experience in her class. These data were aimed to allow the researcher to obtain a better understanding of the learners, learning objectives, and context, which contributed to the analysis stage of actual data—in this case, conference transcripts.

Content Analysis

Content analysis was chosen as the main methodology to analyze the computer conference transcripts: in other words, discussion forum messages to distill the useful elements of their meaning for examining the coconstruction of knowledge in CMC contexts. Studies have shown that the quality of computer conference messages in relation to knowledge construction must be taken into account as a source of learning (Harasim, 1990; Hiltz, 1990).

Before the research began, all participant names were replaced with pseudonyms to assure confidentiality. For the first research objective on social participation in computer conferencing, descriptive statistics, such as the number and length of postings contributed to each topic, were calculated. Additionally, in order to understand the underlying patterns of interaction in the structure of the course, Howell-Richardson and Mellar's (1996) interaction maps that provide visual representations of electronic conferencing, and Henri's (1992) three criteria for conference interactivity (i.e., explicit, implicit, or independent statements) were used together to create conference graphs illustrating the flow of the discussions and the direction of the postings. The unit of analysis for these was selected as the "unit of message."

To answer the second research question (whether or not the interactive nature of CMC exchange support and encourage the construction of knowledge through collaborative learning process), the content of the messages was coded based on Gunawardena et al.'s (1997) coding scheme of interaction analysis model using computer assisted qualitative data analysis package, Atlas.ti. According to Gunawardena et al. (1997), a message as a whole embodies a student's cognitive activity and contribution to the construction of knowledge. Thus, they used the complete messages in discussion forum as the unit of analysis. However, the unit of message did not fit in this study because some messages contained very little information; others contained three or more distinct ideas, comments, complex arguments, or hypotheses addressing different concepts or questions raised during the discussions. Therefore, the unit of analysis was selected as the "unit of thematic (meaning)." Henri (1992) justifies this type of unit of analysis by arguing that "it is absolutely useless to wonder if it is the word, the proposition, the sentence or the paragraph which is the proper unit of meaning, for the unit of meaning is lodged in meaning" (p. 134).

Gunawardena et al.'s framework was slightly modified to make it more relevant and apparent for coders. The primary coder analyzed the data according to this framework (see Table 1) on three separate occasions to validate the coding procedures of the modified model. Descriptive rules along with examples for the coding process were explained to two other coders in a training session. Then, two coders analyzed the data independently. The final intercoder agreement was over 80%.

FINDINGS

Participation Results

Overall participation results in the course are as follows: Students posted a message on the discussion forum approximately two times

per week, spending, on average, 25 minutes per message. In addition, students replied to two messages on average in a week.

Table 2, below, provides an overview of participation levels for each discussion topic area. In terms of the discussion topic "Online Educator," 7 of the 15 students contributed to the discussion in about a 1-month period. The average number of posts per student was 2. For another discussion topic, Attitude, 8 of the 15 students in the class participated in the discussion in about a 3-month period with an average number of 2.4 posts per student. Seven of the 15 students contributed to the discussion topic, *Assessment*, in a 40-day period. The average number of messages per student was 2.6.

According to Table 2, it is apparent that students were in control of the flow of discussions; in other words, they, not the instructor, dominated the discussions. This is most likely because of one of the course goals: to create a constructivist and flexible online learning environment for students to develop cognitively demanding knowledge by interacting with their peers. The instructor was purposefully providing a learner-centered context in which students were in charge of their own learning by responding to others critically and thoughtfully.

The total number of students who participated in those three discussion topics was more or less the same. Total number of messages by students in both "Online Educator" and "Assessment" was the same but less than that in "Attitude." Although "Online Educator" and "Assessment" discussion topics lasted approximately one month in comparison to "Attitude" (lasted about 3 months), total number of words in student messages found in "Online Educator" and "Assessment" was higher than those found in "Attitude." In addition, the instructor's contribution to the discussion made no such difference in terms of the participation level of students.

Interaction Patterns and Phases of Interaction Analysis Model

Findings of the three discussion topics were examined based on different phases of interaction analysis model and visual representation of interaction patterns of each discussion topic.

Findings in "Online Educator"

A majority of units that occurred during the discussion fell into Phase I: sharing and/or comparing information. For instance:

> As I was reading chapter 3 it struck me that probably the most important thing in a distance program, according to McVay is, "the student's ability to obtain information and research materials." (McVay, 54) [PHI/A] She discusses a scenario where 3 students are

TABLE 2
Participation by Topic

Discussion Topic	*Discussion Period*	*Total Number of Students Participated Out of Total Number Enrolled*	*Total Number of Messages*	*Total Number of Instructor Messages*	*Average Number of Posting Per Student*	*Total Number of Words*
Online educator	September 20-October19	7 of 15	14	0	2	2,266
Attitude	September 18-December 6	8 of 15	19	0	2.4	1,941
Assessment	November 2-December10	7 of 15	18	4	2.6	2,441
Total/average		22/7.3	51/17	4/1.3	2.3	6,648/2,216

TABLE 3
Phases of Interaction Analysis Model by Topic

	Phase I		*Phase II*		*Phase III*		*Phase IV*		*Phase V*	
Topic	*n*	*%*	*n*	*%*	*n*	*%*	*n*	*%*	*n*	*%*
Online educator	106	72	12	8	20	13	9	6	1	1
Attitude	46	40	23	20	30	26	16	13	1	1
Assessment	123	82	2	1	18	12	6	4	1	1
Total/average	275	66	37	9	68	16	31	8	3	1

> taking a distance course: 1 in a rural area, 1 in the Australian Outback, and one at a University campus. [PHI/A] Our situations do not mirror McVay's theoretical situation, [PHI/A] but we are all spread out; [PHI/A] some of us at ISU and some of us in rural areas—while some of us are just so busy that it's as if we're in the Outback. [PHI/A]
>
> From the Library Support for Distance Education, one of the important principles they believe should be incorporated into DE is, "Empowerment of students to access information and to perform their own research on a self-service basis." [PHI/A]
>
> The reason why I bring this point about empowerment up is because in my opinion it is vital that students participating in DE already have good research skills and then they also need access. [PHI/A] So, who is responsible #1 to make sure that students (of all ages) have the research skills, [PHI/D] and #2 who will make sure that students have access (not as a product of students shelling out lots of cash)? [PHI/D]
>
> There is so much research on equity in access that I'm sure some of our professors have had a hand in researching. [PHI/A]What are everyone's thoughts? [PHI/D]

The above message, which was coded at Phase I, exemplified two types of statements. Maria, in her message, provides background information citing a resource along with her personal opinion, observation, and reflection. Later, the message concludes by asking questions to trigger a discussion in order to obtain group consensus on the new information. This is an example of the early process of social negotiation of knowledge construction. The following message tries to move the discussion from Phase I/D to Phase III/D by proposing solutions and new statements embodying compromise.

> To answer your second question, once again I think this falls on the schools to provide access. [PHI/D] Now, some students will have access to computers at home, but many in rural, inner city, etc..., will not always have reliable computers for the students to use. [PHII/A] Students can also get access to computers through the community. [PHIII/D]
>
> If we want to make sure that all students get the access that they need, it will have to come through the schools. [PHIII/D]

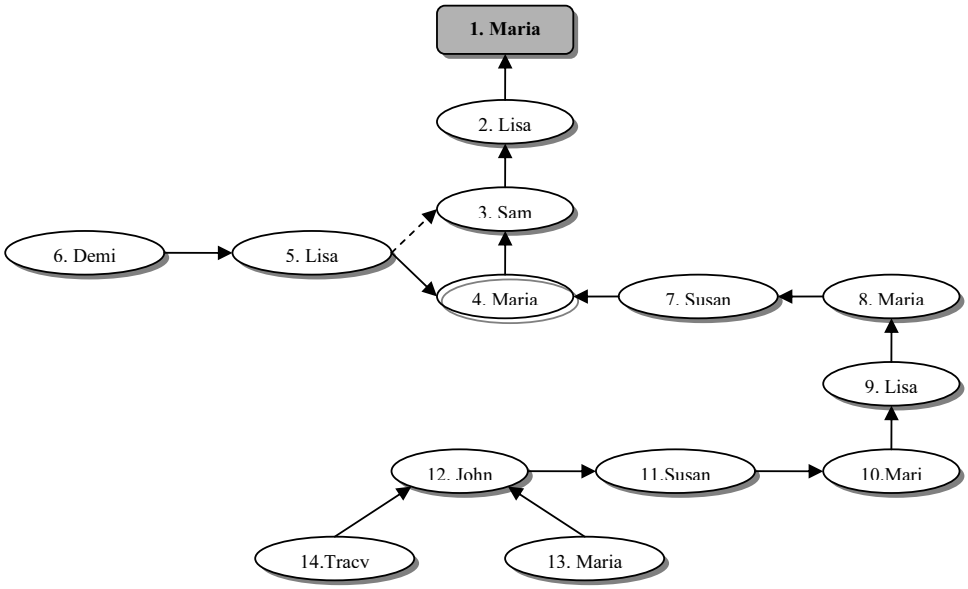
In this example, Lisa tries to answer the question posed by another student to classify the details of the statement. She develops her existing framework of knowledge by exploring inconsistent areas of the statement. Then, she tries to create solutions for that inconsistency by proposing new statements.

In "Online Education" (see Figure 1), the discussion was quite straightforward; every student responded to the previous comment, except for comments #5, #7, and #14. Maria played an important role at some critical points during the discussion. Most of the responses were made to her comments. Therefore, she was not only the starter of the conversation but also, perhaps most of all, the person who kept the discussion continued and summarized it. In short, she played the role of an instructor or a facilitator. In fact, she triggered the discussion

which gave rise to more richness in postings in terms of higher phases of Interaction Analysis Model. The following segment of a posting is another example for three phases from sharing/comparing information to the negotiation of meaning and knowledge. First, the student corroborates an example provided by the previous message. Second, she specifically identifies the area of agreement. Third, she asks a question to clarify the source of inconsistency of a concept into her existing framework of knowledge and thinking skills. Finally, she proposes and negotiates new solutions and statements.

> In middle school we are always working to make students accountable. [PHI/C] I totally agree with you there, [PHIII/A] but do we set DE up for failure when it is in its infant stages in most arenas of society? [PHII/B] We have to make those support networks strong, first before we let the students take the full responsibility. [PHIIID] That way when they are in DE, they have strong support, [PHIIID] and we let DE and the student begin,/continue class together—there will be more of a chance for success. [PHIIID]

It was found that student postings were more explicit and directly referred to others in



: Initial prompt

: Participant Posting

: Indicates direction of explicit posting

: Indicates direction of implicit posting

: Set of postings replied by participant(s) at a time

FIGURE 1
Interaction Map of Online Educator

their content when there was a starter and facilitator in online discussion.

Findings in "Attitude"

In "Attitude," every message was connected either explicitly or implicitly (see Figure 2). Four messages (#4, #15, #16, and #19) referred to multiple messages. In addition, unlike in "Online Educator," some specific postings were referenced by more than one student. Discussion evolved from two different points: first, it started with Maria's initial prompt and, second, it developed with Sam's respond to Lisa; that was when the direction of the discussion separated into three legs. It was also found that students were beginning to pay attention to multiple threads as the discussion progressed and the discussion became more continuous and engaging, especially in the later stages. In comparison to "Online Educator," there was a synergistic interaction among students in "Attitude."

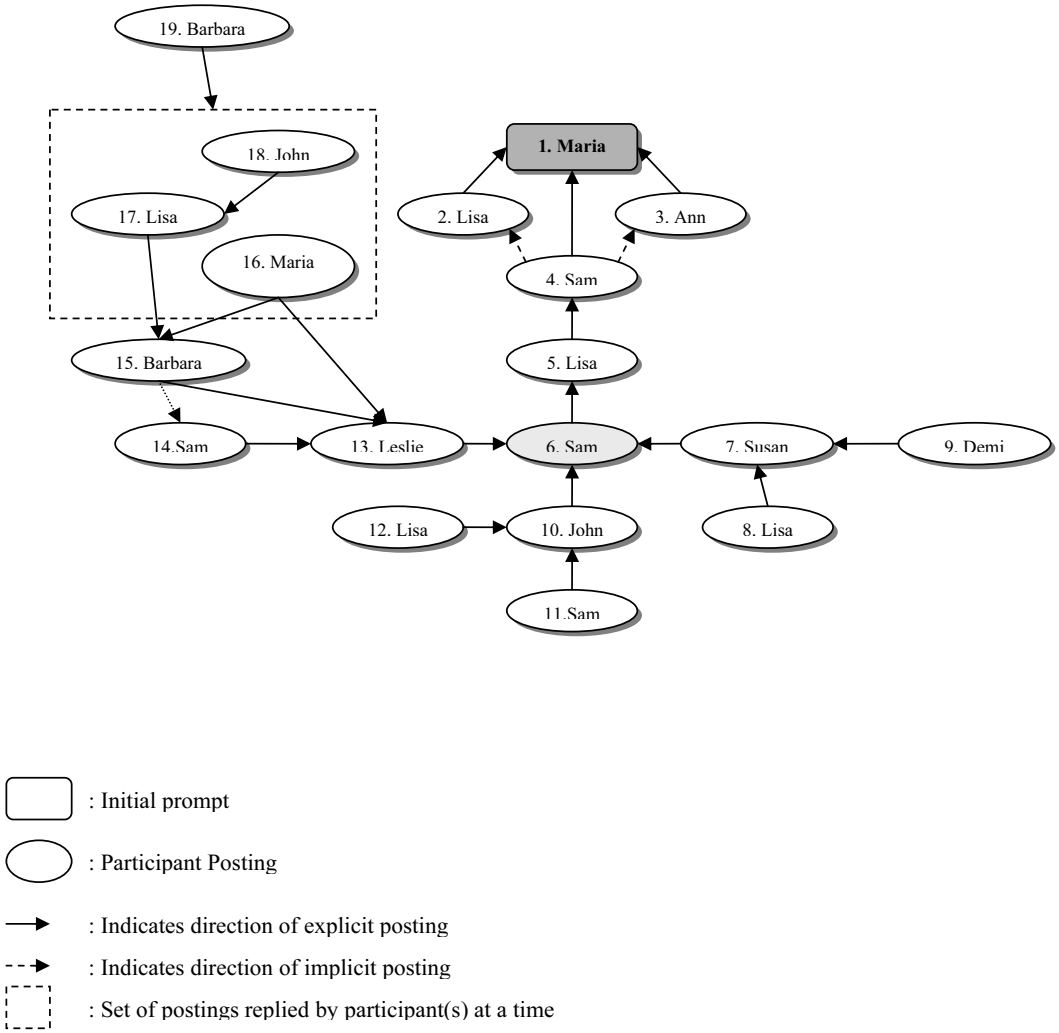


FIGURE 2
Interaction Map of Attitude

Findings also revealed that some students posted their messages at some point when the discussion had already progressed for a while. For instance, Leslie (#13) replied to Sam's comment and created another thread after two threads including six postings related to Sam's message had already been developed. Likewise, Maria (#16) posted her second message at the end of the discussion, although she was the starter of the discussion. This might be because asynchronous online communication within a learning environment provides students with an opportunity to participate in discussions any time. However, discussion might have changed or lost its tendency or direction when a student accessed the Internet.

Of the three discussion topics, "Attitude" had the highest percentage of Phase II (20%), Phase III (26%), and Phase IV (13%). The evidence of higher phases was observed, in particular, when the discussion became more engaged and interactive as it progressed. For instance:

> Leslie (#13): The mentor is also the person that could give the DE student that social benefit. [PHIII/A] If the mentor acts as an advocate for the student, perhaps gets to know them more on a personal level, then the DE student might be more apt to have a good attitude about the class, even when the class work get rough. [PHIII/D]
>
> But, even the students with the best attitudes can lose motivation and start feeling insecure. [PHII/A] If there are good people supporting the program (teacher, mentor, counselor, parent community), the students will have a much better chance of a successful learning experience. [PHIII/D] So, in many ways the DE program is only as good as the people that support it. [PHIII/E]
>
> Barbara (#15): Tying in attitude and the cultural differences we have been discussing I am wondering if some cultures would do better with attitude. [PHIV/A, B] I am thinking specifically of Asian countries where the martial arts are taught. I am currently taking Taekwondo and positive attitude and perseverance are two of the tenants that are taught. [PHIV/C]

In the example above, we see how a discussion develops from Phase III (sometimes iteratively, from Phase III back to Phase II) when Leslie integrates and synthesizes the information through coconstruction of knowledge, to Phase IV, when Barbara tests the proposed synthesis against both received fact as shared by others and her existing cognitive schema as well as her experience.

It was interesting to find out that although there was no teacher presence, discussions moved from early phases to later phases. Therefore, it is possible that meaningful, critical, and reflective discussions can occur without the presence of an instructor. This indicates that computer-mediated conferences can promote social construction of knowledge and collaborative learning in a constructivist learning context.

Findings in "Assessment"

Like the discussion in "Online Educator," a majority of the units fell into the Phase I in "Assessment." In fact, "Assessment" had the highest percentage of Phase I (82%) and the least percentage of other Phases of the three topics. For instance, in the following message, Barbara provides a statement of opinion that culminates in a question and asks questions to classify the details of the statement. Sam answers Barbara's question and also shares her rubric as an attachment, which is used for her own class.

> Barbara: I like your use of rubrics with the students. [PHI/A] I think it is something teachers should do more of. [PHI/A] I do have a few questions though.
>
> If you have students who are always going for the C grade when you know they can do better what do you do to get them to challenge themselves? [PHI/D]
>
> How do you explain to parents that their child settles for doing C work? [PHI/D]

> How do you take into account the struggling student who works very hard to earn a C versus the students who earn a C because they do not try as hard as they could? [PHI/D]
>
> Sam: Great ?'s never a bad question. [PHI/A] Some of my students do always do the "C" requirements [PHI/C] but what they don't know is that with each project the "C" is actually a little tougher then the previous "C" so that they are always building. [PHI/C] Some parents do have concerns but when we discuss it, it usually opens up some eyes as to how a student may be doing in other classes as well. [PHI/C] Doing the min. needed to get by. [PHI/C]Overall most students do strive for the higher grade. [PHI/C] I put the really cool stuff in that area. [PHI/C] Using digital camera, making power points. [PHI/C]The "C" grade is usually a narrative and demonstration of skills. [PHI/C]All my students seem to be able to handle the rubrics from my three autistic boys to my higher level thinking students and those in between. [PHI/C] One of the phrases that I am famous for saying, right or wrong is "Remember, if you put crap in you get crap out. So do your best and expect no less." [PHI/A] Not pretty but the kids get it! [PHI/A] I just looked at my "Rubrics" and the one I am attaching is not in the traditional rubric format but it will give you an idea of how they can pick what they want to do from the requirements listed. [PHI/C] I sometimes call it the "smorgasbord approach" pick and choose what you want to do for the grade you want. [PHI/C]

Except the units reflected Phase I, most of them fell into the Phase III. Findings revealed that a number of units jumped into the Phase III, negotiation of meaning and coconstruction of knowledge from Phase I, sharing and comparing information, as quoted below.

> I think rubrics are great for all levels of students--those struggling to get the C and those for whom an A comes easy. [PHI/A] This may be especially true at the k12 level. [PHI/A] The way I understand rubrics is they outline both the level and quality of work to be completed. [PHIII/A]
>
> A "c" student (if they desire) can attempt to meet both and although their final product may be something different than the typical "a" student, they could end up with the equivalent grade because of meeting the rubric description. [PHIII/A] In contrast an "a" student can push themselves to perform at an even higher level based on how they interpret the rubric's description and as a result feel challenged and more satisfied with their learning experience. [PHIII/A]

In this example, the message begins at Phase I, making a statement of opinion on the concept of "using rubrics for assessment," and goes to Phase III to negotiate and clarify the meaning of rubrics building on others' ideas.

"Assessment" was the only topic of the three that had a teacher presence (see Figure 3). The instructor posted a prompt to start the discussion and contributed with three other messages during the discussion: her second message was another prompt that was posted after the first one supporting the previous one with explanations, examples, and resources where students could find information. The other postings of the instructor were initiating prompts such as "Now it is another person's turn to answer a question" or "Also think about informal assessment for your ILO Orientation, what and how?" All posts of the instructor were coded as Phase I (sharing/comparing of information). Overall, her role can be described as a trigger or starter of the discussions.

The discussions in the "Assessment" topic mainly followed the questions or comments posed by key participants. In this discussion, the key participants were the instructor and Barbara (see Figure 3). Barbara, especially, played a role of a facilitator by providing arguments, resources, examples, and responses to others. She also acted as a summarizer of the messages, which gave more structure to the discussion and made it more engaging. For instance, Barbara (#11) not only implicitly responds to others who made comments about her previous posts, but also explicitly responds to a peer by making a statement of agreement, sharing more infor-

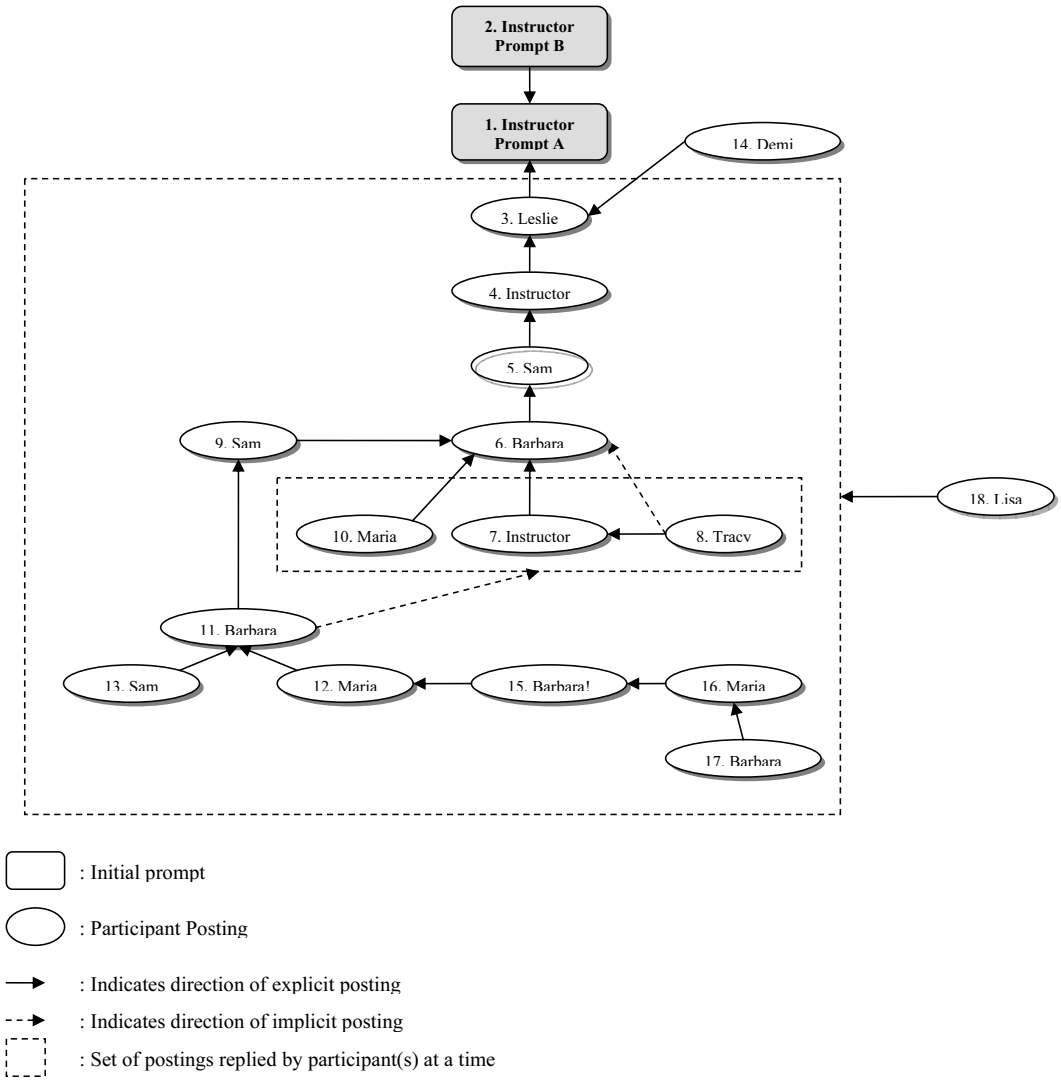


FIGURE 3
Interaction Map of Assessment

mation, and finally asking more initiating questions to carry on the discussion.

Although the structure of the discussion does promote interactive communication among students, the quality of responses by both students and instructor did not seem to support the desired learning experience, in which the development of higher-order thinking skills and cocreation of knowledge take place. Rather, the responses were largely at the lower level of Interaction Analysis Model.

DISCUSSIONS AND IMPLICATIONS FOR PRACTICE

The analysis of data gathered for the content analysis showed that the predominance of messages fell into the first phase of knowledge con-

struction-sharing and comparing information. One possible reason for the vast majority of interaction occurred at the first level could be due to the lack of course structure for online discussions. The instructor provided an environment for students in which anyone can create a topic and start conversation, which can take place even through the end of the course. According to data, there were 18 on-going discussion topics to which students were expected to contribute actively and learn from others' postings. This type of structure could put a lot of effort and energy on a student to concentrate on a topic in order to make critical reflection and provide thoughtful comment. For this reason, some students participated in a discussion just because they were required (at least three times on a weekly basis). Thus, some messages did not include meaningful contribution to the development and flow of the discussion, thus, social construction of knowledge. In addition, the lack of timely manner discussion could also give rise students to lose their interest on a topic, and perhaps the topic loses its value. According to the findings, the level of overall participation in the course and the participation in three discussion topics was at a low level.

Another possible reason for the little presence of high phases of knowledge construction could be due to the lack of a facilitator or a moderator of the discussion. Although the majority of discussions were a sharing and comparing of information, content analyses also revealed that students processed information at high levels of knowledge construction process. This usually took place there was strong model of a facilitator or a moderator. In addition, it was also observed from interaction maps that the meaningful remarks made by a facilitator promoted the quality and quantity of interaction among students as in the discussion topic "Attitude."

Pedagogical Recommendations

Based on careful examination of the data, the quality and quantity of interaction was influenced by the structure of a discussion. The first recommendation is for instructors to structure discussions in a way that students will have a common set of rules for discussions including participation requirements, certain dates for initial posts, established discussion topics, and description of the length and the quality of messages. Creating a set of rules for students to engage in a discussion increases dialogue and interaction. In addition, instructors should also structure a discussion in a timely manner (e.g., one discussion per week) so that students will have an opportunity to gather their attention and focus on that discussion and make prompts critically and reflectively.

The second recommendation would be for instructors to be active members in discussion. Instead of acting as a traditional authoritarian teacher who is staying behind the scene and observing the actions taken by students, the instructor should take action frequently by reading the postings and joining discussions either to give feedback or to provide information when necessary. Teacher presence is important in that instructors play a significant role in guiding students toward higher levels of learning (Anderson, Rourke, Garrison, & Archer, 2001). As seen in the discussion topic "Attitude," students could play instructor's role as being a facilitator or a moderator. According to Hara et al. (1998), the discussion moderator "is a key player in determining the depth of dialogue and overall knowledge generation processes " (p. 28). In order to stimulate students to develop reflective and higher-order thinking skills, the postings of the moderator ought to reflect the high level of meaning negotiation and knowledge construction. Gunawardena et al. (1997) point out that the moderator "is open to conceptualizing the learning process as joint construction of knowledge and negotiation of meaning" (p. 428).

CONCLUSIONS

Understanding the experience of learning and the overall pattern of knowledge construction that emerges from computer-mediated confer-

encing assists educators to acquire intended and worthwhile learning outcomes. This study explored the dynamics of learning community at a graduate level course facilitated by computer-mediated conference in terms of two main concern areas: interaction patterns and knowledge construction through social negotiation among students.

The Interaction Analysis Model of Gunawardena et al. (1997) was found to be a useful model to investigate an evidence of knowledge construction. However, the model needs to have more specific indicators and distinctive explanations for categories within phases. It also needs to be more explicit and narrow in its early phases and more descriptive and distinctive in its later ones. Using the Gunawardena et al. model (1997), coconstruction of knowledge was found primarily at the first phase as a result of students' conversation. On the other hand, several exchanges showed evidence of movement from Phase I to higher phases. The findings show that a lack of structured, organized discussion, and the absence of a moderator may have contributed to these results.

Rich instructional systems and learning experiences can be designed by understanding how knowledge is constructed and distributed in a CMC environment. Further research is needed in understanding how students develop cognitively demanding knowledge through computer conferences. The instructional factors and pedagogical strategies that affect knowledge construction in a collaborative online learning environment could be examined further. These studies would help us understand and provide us with the richness and potential of computer conferencing in the learning experience.

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